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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: <b>PCT/GB00/01196</b>		<b>Published</b>
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(60) Parent Application or Grant NOR. WEB DPL LIMITED [/]; (.) BROWN, Paul, Anthony [/]; (.) SUMMERSCALES, Brian [/]; (.) BROWN, Paul, Anthony [/]; (.) SUMMERSCALES, Brian [/]; (.) HACKNEY, Nigel, J. ; (.)		
(54) Title: COUPLING APPARATUS AND METHOD (54) Titre: APPAREIL ET PROCEDE DE COUPLAGE		
(57) Abstract  The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables. Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable (2), where the cable includes an electrically insulated conducting member (1), where the coupling apparatus includes cable insulation penetration means (3) for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means (3) being electrically connected to a coupling member (5) suitable for connection to a telecommunications signal source or receiver. In this way, a coupling member suitable for connection to a telecommunications signal source or receiver may be electrically connected to the conducting core of a power cable or other type of conductor.		
(57) Abrégé  L'invention concerne un appareil de raccordement destiné à être couplé à un conducteur ou un câble et, plus particulièrement, un appareil de raccordement haute fréquence approprié pour des signaux de télécommunication diffusés, au moins partiellement, par des câbles de distribution de puissance. En conséquence, dans un premier aspect, l'invention concerne un appareil de raccordement conçu pour être couplé à un câble électrique (2), qui comporte un élément conducteur isolé électriquement (1). L'appareil de raccordement comporte un dispositif de pénétration d'isolation (3) du câble destiné à pénétrer le câble électrique afin d'établir une connexion électrique avec l'élément conducteur, le dispositif de pénétration (3) étant électriquement connecté à un élément de raccordement (5) conçu pour être connecté à une source ou à un récepteur de signaux de télécommunication. De cette manière, un élément de raccordement conçu pour être connecté à une source ou à un récepteur de signaux de télécommunication peut être électriquement connecté au noyau conducteur d'un câble de puissance ou à un autre type de conducteur.		

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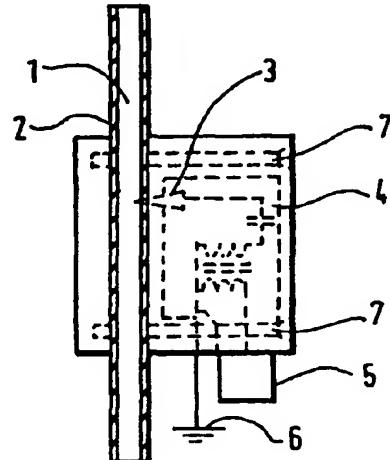
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(75) Inventors/Applicants (for US only): BROWN, Paul, Anthony [GB/GB]; 30 Apperlyrigg, Kendal, Cumbria LA9 6EA (GB). SUMMERSCALES, Brian [GB/GB]; 68 Bolshaw Road, Head Green, Cheadle, Cheshire SK3 3PD (GB).		With international search report.
(74) Agents: HACKNEY, Nigel, J. et al.; Mewburn Ellis, York House, 23 Kingsway, London WC2B 6HP (GB).		

(54) Title: COUPLING APPARATUS AND METHOD

(57) Abstract

The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables. Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable (2), where the cable includes an electrically insulated conducting member (1), where the coupling apparatus includes cable insulation penetration means (3) for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means (3) being electrically connected to a coupling member (5) suitable for connection to a telecommunications signal source or receiver. In this way, a coupling member suitable for connection to a telecommunications signal source or receiver may be electrically connected to the conducting core of a power cable or other type of conductor.



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**Description**

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COUPLING APPARATUS AND METHOD

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The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it  
15 refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables.

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The transfer of communication signals along electricity  
25 distribution and/or transmission networks is a promising development in the telecommunications industry. The  
30 communication signals may be transferred even whilst the power cables/conductors are energized.

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15 Various technical aspects of systems whereby telecommunications signals can be conveyed along an electricity distribution and/or transmission network are disclosed in published patent applications of the present applicant. These applications include the following:  
40  
45 20 WO94/09572, WO95/29572, WO95/29537, WO96/07245,  
50 WO98/19398, the disclosures of which are incorporated herein by reference.

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It is desirable that the coupling of telecommunication signals onto power distribution and/or transmission networks be achieved in a safe, efficient and cost-effective way.

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The present invention aims to provide a method and apparatus for effectively coupling communication signals onto and off an existing, possibly energized, mains electricity distribution and/or transmission network.

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Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable, where the cable includes an electrically insulated conducting member, where the coupling apparatus includes cable insulation penetration means for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means being electrically connected to a coupling member suitable for connection to a telecommunications signal source or receiver.

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In this way, a coupling member suitable for connection to

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10 a telecommunications signal source or receiver may be  
electrically connected to the conducting core of a power  
cable or other type of conductor.

15 5 Thus the coupling device could be retro-fitted to an  
existing power distribution and/or transmission network.  
To minimize disruption to consumers' power supplies and  
20 to avoid time-consuming installation, preferably the  
coupling device should be adapted to be fitted to, for  
25 example, an insulated power cable without disconnecting  
10 that power cable from the power source, i.e. while the  
30 cable is "energized" or live.

35 The coupling member is electrically isolated at low  
15 frequencies (e.g. 50/60 Hz or possibly up to 100 or 200  
Hz) from the insulation penetration means using a low  
40 frequency protection means such as a high pass filter,  
for example a suitable capacitor. Furthermore, the  
coupling member may be electrically protected from the  
45 20 cable insulation protection means by, for example a fuse  
and/or transformer, e.g. a balun transformer.

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The insulation penetration means is adapted to pierce a  
10 sleeve of electrical insulation material around the power  
cable or conductor and hence come into and establish  
electrical contact with the electrical current carrying  
15 5 part of the conductor. In this way, the coupling device  
is suitable for attachment to a power cable or conductor  
20 at many different places along the cable or conductor  
length.

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10 In some instances, it might not be desirable for the  
electronic components to be attached to the cable at all  
30 times. Accordingly, in a second aspect, the present  
invention provides a coupling device including a clamp  
and a clamp head. The clamp includes the insulation  
35 15 penetration means and means for fitting the insulation  
penetration means to the cable. The clamp head includes  
40 a coupling member suitable for connection to a  
telecommunications signal source or receiver. The  
coupling member is preferably protected by low frequency  
45 20 protection means such as a high pass filter, for example  
a suitable capacitor. Furthermore, the coupling member  
50 may be electrically protected from the cable insulation

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penetration means by, for example, a fuse and/or balun  
10 transformer.

In a preferred embodiment of the present invention, one  
15 5 end of the primary winding and/or one end of the  
secondary winding of the transformer is/are electrically  
20 bonded to an earth potential. Furthermore, in another  
preferred embodiment, one end of both the primary and  
secondary windings of the transformer are electrically  
25 10 bonded to the same earth potential.

In another preferred embodiment of the present invention,  
30 the cable insulation means includes a spike.  
Additionally or alternatively, this spike may be rigid.  
35 15 Additionally or alternatively, the spike may be  
electrically conducting. Additionally or alternatively,  
40 there may be a plurality of spikes, preferably spaced 0.5  
- 1.5cm apart, most preferably around 1cm apart.

45 20 Preferably, the present invention includes clamping means  
for urging the penetration means into the cable the  
50 clamping means may include a screw operated compression

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member.

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Preferably, the present invention includes a housing which, in use, fits around the cable.

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In another preferred embodiment of the present invention, the coupling apparatus includes a two part housing, the first part containing the coupling member and the second part containing the penetration means wherein the two parts are releasably joined together. Preferably, the clamping means is included in the second part of the housing.

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Preferably, the cable insulation penetration means and the coupling member are electrically connected via a conducting spring.

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Embodiments of the present invention will now be described with reference to the accompanying drawings in which:-

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Figure 1 is a schematic diagram of a coupling device

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according to a first embodiment in which the main  
10 internal components are illustrated.

15 Figure 2 is an exploded schematic diagram of a coupling  
5 device according to the first embodiment, showing the  
device in its two main component pieces.

20 Figure 3 is an exploded schematic diagram of a coupling  
device according to the first embodiment, corresponding  
25 to a section viewed in a plane which is perpendicular to  
10 the axis of the cable at the line marked "X-X" in Figure  
30 2.

35 Figure 4 is a schematic diagram of a coupling device  
15 according to a second embodiment in which the main  
internal components are illustrated.

40 Figure 5 is an exploded schematic diagram of a coupling  
device according to the second embodiment, showing the  
45 20 device in its three main component pieces.

50 Figure 6a is a side view of a coupling device according

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to a further embodiment of the present invention;

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Figure 6b is an end view of the device of Figure 6a;

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5 Figure 7a is a side view of a further embodiment of a coupling device according to the present invention; and

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Figure 7b is an end view of the device of Figure 7a.

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10 Figures 1, 2 and 3 show a coupling device according to the first embodiment of the present invention. The unit consists of two parts 21 and 22, constructed in part using a strong, non-conducting material, which are clamped tightly together using, for example, two screws

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35 15 The device is preferably clamped across an insulated power cable 2. The outline of the unit is preferably shaped to fit an insulated cable 2 between the two parts of the coupling device 21 and 22. For example, the outline of the coupling device is concave, as shown in

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45 20 Figure 3. The insulation penetration means preferably includes a rigid conducting spike 3. This spike protrudes a pre-set distance into the concave outline of

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the unit. The insulation 8 is pierced and electrical contact is made between the rigid conducting spike 3 and the metallic power conductor 1 as the clamping screws 7 are tightened.

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The rigid conducting spike 3 is electrically connected to a circuit 4, schematically shown in Figure 1. This circuit preferentially includes one or more protection devices such as a fuse and a balun transformer. The circuit further includes a low frequency protection device such as a high pass filter for the high frequency communication signals, for example a suitable capacitor. The circuit is provided with a coupling member such as a communications signal input/output port, typically a coaxial, unbalanced, high frequency, standard BNC connector 5 well known in the art. Preferably, a safety earth is attached via 6 in Figure 1. Additionally or alternatively an isolation capacitor may be included on the "braid" side of the coaxial connector 5 in order to isolate it from the mains electricity supply in the event of a fault.

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In this first embodiment, the circuit 4 is entirely contained within the insulating casing of the device. Therefore, during installation of the coupling device, no 'live' conducting elements are exposed, either on the cable or on the device itself.

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Figures 4 and 5 illustrate a coupling device according to a second embodiment of the present invention. The device is constructed in part using a strong, non-conducting material and is made up of three main parts 51, 52 and 53. Main parts 51 and 52 are shaped, for example in a concave sense, so that an insulated cable 31 may fit between them in a similar sense to the first embodiment, shown in Figure 3. Parts 51 and 52 may be clamped tightly together using a single screw 40. A rigid conducting spike 34, similar to a spike 3 in the first embodiment, protrudes a pre-set distance into the concave outline of part 52. The insulation 42 is pierced and electrical contact is made between the rigid conducting spike 34 and the metallic power conductor 32 as the clamping screw 40 is tightened.

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The rigid conducting spike may be electrically connected to a fuse carrier and link 36 via a conducting spring 35 when the clamp 33, made up using main parts 51 and 52, is attached to a clamp head 37 (or 53) via screws 41. The 10 clamp head contains a circuit 36, preferentially including protection devices such as a fuse and a balun transformer. The circuit further includes a low frequency protection device such as a high pass filter for high frequency communication signals and is similar 15 to the circuit 4 described in outline in the first embodiment of the invention. The circuit 36 is provided with a coupling member such as a communications signal 20 input/output port, typically a coaxial, unbalanced, high frequency, standard BNC connector 38 well known in the 25 art. Preferably, a safety earth is attached via 39.

30

The second embodiment of the present invention allows the 35 clamp head 53 to be easily removed from the cable clamp 40 51 and 52 whilst, if desired, leaving the cable clamp 51 45 and 52 still attached to the cable. The cable clamp may 50 then be covered using a fascia plate. This removes the need to place an insulating sleeve over the puncture hole

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in the cable insulation if it is required to remove the coupling device from the cable at some later date.

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The embodiment of the invention shown in Figures 6a and 15 6b consists principally of a first part 60 of the coupling unit and a saddle 61. As will be seen, the saddle 61 sits on top of the coupling unit part 60. The saddle may, for example, be made of steel and may be around 20 x 30 x 3mm in size including a tapped hole for 10 receipt of a screw 62, with for example a 5mm thread.

In use, the unit 60 is placed against an insulated cable 63 to a conductor of which contact is required to be made. Initially, the saddle lies against or adjacent the 15 top of the part 60 as shown in Figure 6a. The contacts (not shown) project against the cable 63.

One or more cable ties 64 (in this embodiment, two ties are used) secure the unit 60 against the cable 63. In 20 this embodiment each of the cable ties 64 is located on a respective side of the screw 62 and also serve to hold the saddle against the unit 60. As will be seen more

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clearly in Figure 6b, the eye 65 of each cable tie abuts  
10 against a square edge 66 of the saddle 61. By contrast,  
the edge 67 of the saddle 61 over which the elongate  
15 portion of the cable tie 64 lies is rounded so as to  
5 relieve the stress on the cable tie. Also optionally  
provided are locating notches in the saddle 61 (not  
20 shown) which serve to locate the elongate portion of the  
cable ties 64. In some embodiments, the rounded edges  
mentioned previously may only be provided in the locating  
25  
10 notches.

30 Once the cable ties have been tightened as much as  
possible by hand in the conventional manner, the machine  
screw 62 may then be operated (in this case turned  
35 15 clockwise) so that its end moves against the top of the  
unit 60 and forces the saddle 61 away from the unit 60.  
This action serves to drive the electrical connection  
40 spikes through the installation cable 63. As will be  
apparent to the skilled person, means other than the  
45 20 screw 62 may be provided to perform this same function.

50 Figures 7a and 7b show a further embodiment of the

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present invention which is similar to the embodiment of  
10 Figures 6a and 6b with the exception that the saddle is  
omitted. The cable tie locating notches may instead be  
formed directly in an upper edge 70 of the unit 71.

15 5 Means are provided inside the unit 71 (not shown) for  
moving the tips of the electrical connection spikes in a  
20 direction away from the unit 71 so that, in use, the  
spikes extend further towards the cable 72. These means  
are operable by, in this example, rotation of a rod head  
25 10 73 which is located on the top surface of the unit 71.  
Naturally other means for operating the spike driving  
30 means will be apparent to the skilled person and may be  
used instead.

35 15 In use, the unit 71 is placed adjacent the cable 72 and  
the cable ties 74 are tightened by hand as previously.  
40 The rod 73 (which may be made of nylon of, for example a  
millimetre diameter) is then operated (e.g. turned  
45 clockwise) to drive the contact spike(s) out of the base  
20 of the coupler into the cable thereby tensioning the  
cable ties and piercing the cable insulation to make  
50 contact with the conductor.

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In either of the embodiments of Figure 6 or Figure 7, or  
indeed in any of the embodiments described previously,  
the base 68, 78 of the unit 60, 71 may be shaped  
differently to that shown in the drawings. In a  
15 preferred embodiment, the base 68, 78 may be shaped so as  
to conform more closely to the surface shape of the cable  
which, in this example, is roughly circular. This  
20 enables the unit 60, 71 to be more easily located against  
the cable.

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Each of the embodiments of the present invention  
described above may be self supporting in that they are  
supported only by the cable to which they are clamped.  
A further embodiment of the invention includes having one  
35 15 or more lugs attached to the clamp devices. In this way,  
the clamps themselves may be attached to a suitable  
40 surface.

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Furthermore, the embodiments described above are also  
suitable for coupling communications signals to/from  
cables with more than one conducting core. In this way,  
50 a range of, for example differential, phase to phase,

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phase to neutral/earth, phase to earth, neutral to earth  
or polyphase modes of high frequency signal coupling may  
be provided.

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5 As will be appreciated, the above embodiments are given  
by way of example only and modifications will be apparent  
to those skilled in the art.

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**Claims**

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CLAIMS

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1. A coupling apparatus suitable for coupling with an electricity cable, where the cable includes an electrically insulated conducting member, where the coupling apparatus includes cable insulation penetration means for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means being electrically connected to a coupling member suitable for connection to a telecommunications signal source or receiver.

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2. A coupling apparatus according to any one of the above claims including a clamp and a clamp head, wherein the clamp includes the insulation penetration means and means for fitting the insulation penetration means to the cable, and the clamp head includes the coupling member.

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3. A coupling apparatus according to claim 1 including low frequency protection means for electrically

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isolating the coupling member at low frequencies  
from the insulation penetration means.

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4. A coupling apparatus according to claim 1 or claim  
5 including a fuse and/or transformer by which the  
coupling member may be electrically protected from  
the cable insulation protection means.

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5. A coupling apparatus according to claim 4 in which  
10 one end of the primary winding and/or one end of the  
secondary winding of the transformer is/are  
30 electrically bonded to an earth potential.

35

6. A coupling according to claim 5 in which one end of  
15 both the primary and secondary windings of the  
transformer are electrically bonded to the same  
40 earth potential.

45

7. A coupling apparatus according to any one of the  
20 above claims wherein the cable insulation means  
includes a spike.

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10 8. A coupling apparatus according to any one of the  
above claims including clamping means for urging the  
penetration means into the cable.

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10 5 9. A coupling apparatus according to any one of the  
above claims including a housing which, in use, fits  
around the cable.

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10 10. A coupling apparatus according to any one of the  
above claims wherein the cable insulation  
penetration means and the coupling member are  
30 electrically connected via a conducting spring.

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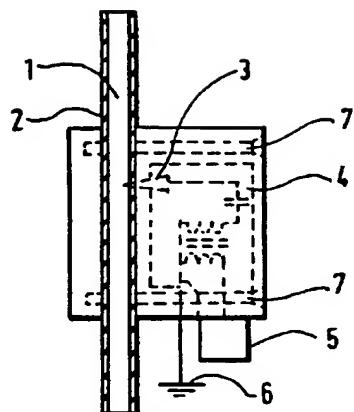


Fig.1.

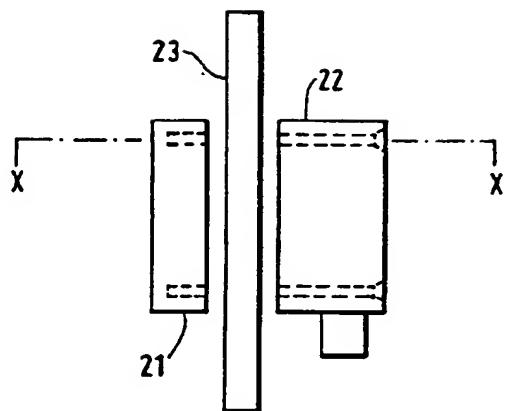


Fig.2.

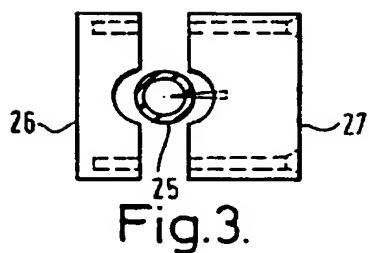


Fig.3.

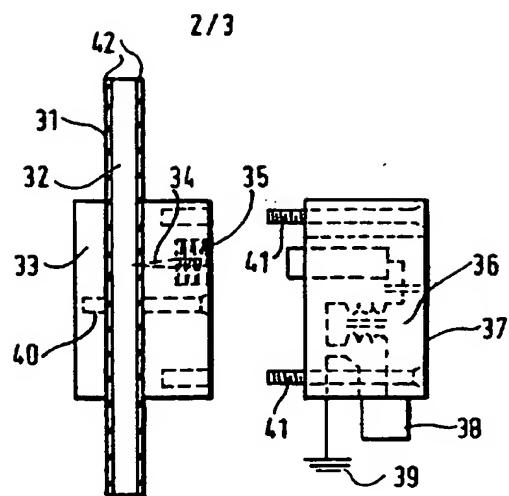


Fig.4.

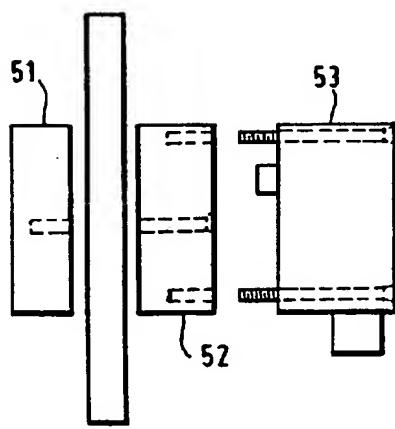


Fig.5.

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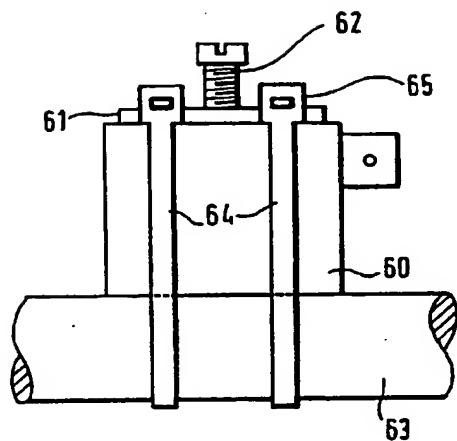


Fig.6a.

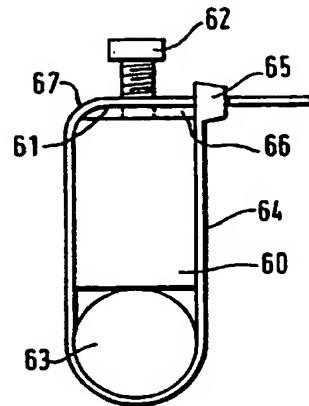


Fig.6b.

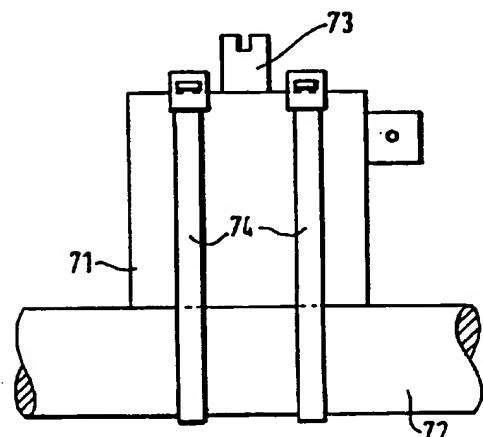


Fig.7a.

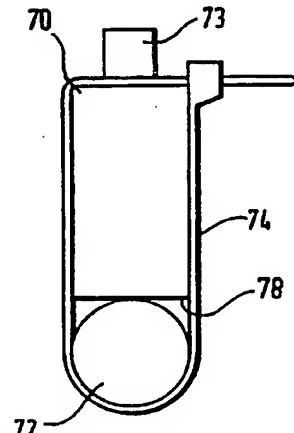


Fig.7b.

**INTERNATIONAL SEARCH REPORT**

International Application No  
PCT/GB 00/01196

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 HO1R4/24

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 HO1R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 283 012 A (SUMITOMO ELECTRIC INDUSTRIES) 21 September 1988 (1988-09-21) column 2, line 52 -column 4, line 38; figures 2,4,5	1,2,7-9
X	US 5 367 251 A (MCTIGUE JAMES F) 22 November 1994 (1994-11-22) column 5, line 20-68; figure 3	1,7-9
X	EP 0 471 630 A (GREILLIER BERNARD) 19 February 1992 (1992-02-19) column 3, line 14 -column 4, line 26 figures 2-4	1,8,9
X	WO 98 45896 A (WHITAKER CORP) 15 October 1998 (1998-10-15) claim 1; figures 1,3	1,8,9
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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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8 June 2000	19/06/2000

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl. Fax: (+31-70) 340-3016	Authorized officer Waern, G
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## INTERNATIONAL SEARCH REPORT

Inte	nal Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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X	PATENT ABSTRACTS OF JAPAN vol. 013, no. 366 (E-806), 15 August 1989 (1989-08-15) & JP 01 122576 A (FURUKAWA ELECTRIC CO LTD:THE), 15 May 1989 (1989-05-15) abstract; figures 1,2 -----	1,7,8
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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

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